

REMARKS

The Applicants' note with appreciation the Examiner's identification of allowable subject matter in claims 5, 6, 7 and 14-24. The following amendment amends the specification and claims 1, 6, 8, 13, 14, 15, 18, 23, and 24 to more clearly define the subject matter of the invention, and adds new claims 25-72. Now in the application are claims 1-72 of which claims 1, 8, 25, 41 and 57 are independent. No new matter is added. The following comments address all stated grounds for rejection and place the presently pending claims, as identified above, in condition for allowance. Attached hereto is a marked up version of the changes made to the specification and claims by the current amendments. The attached page is captioned **"VERSION WITH MARKINGS TO SHOW CHANGES MADE"**.

With regard to the Examiner's objection to the specification at page 13, lines 29-33 the cited passage is not contradictory to the Applicants' invention. In the illustrative embodiment discussed in the cited passages, the downstream portion of the radiator plate 74 is constructed from a synthetic a resin. As such, the downstream portion of the radiator plate 74 is made thinner to increase the amount of heat transfer between the cooling air and the downstream cells, while the upstream portion of the radiator plate is made thicker to retard the heat transfer and, hence, provide a desirable thermal equilibrium across or between each of the cells along the air passage.

Rejection under 35 U.S.C. § 112:

Claims 6, and 8-24 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regards as their invention. Applicants have amended Claims 6, 8, 13, 15, 18, and 23, to clarify and more particularly point out and distinctly claim the subject matter that applicants regard as their invention. The above amendments adopt several of the Examiner's suggested clarifications by replacing the term "heat condition" in each of the claims with "heat load". Applicants contend that the phrase "heat load" is supported by the specification at page 2, lines 17-20, and further contend that the phrase "heat load" is well-recognized by one skilled in the art.

Accordingly, applicants request that the rejections under § 112 be reconsidered and withdrawn.

Claim Rejections under 35 U.S.C. § 102

For purposes of clarity in the discussion below, the respective rejections under 35 U.S.C. § 102 are discussed separately.

A. Rejection of Claims 1 and 2 under 35 U.S.C. § 102(a):

The Office Action rejects Claims 1 and 2 as being anticipated by EP 0994523 A1 (hereinafter “Europe”). Applicants’ respectfully traverse this rejection based on perfecting a right of priority under 35 U.S.C. § 119.

The cited Europe reference fails to qualify as prior art under 35 U.S.C. § 102. Filed herewith are English language translations for each of the certified priority documents and two verifications of translations from the translator to perfect Applicant’s right of priority, in accordance with 37 C.F.R. 1.55(a)(4).

Accordingly, Applicants’ request that the rejection of Claims 1 and 2 under 35 U.S.C. § 102(a) be reconsidered and withdrawn.

B. Rejection of Claims 8-12 under 35 U.S.C. § 102(b):

The Office Action rejects Claims 8-12 as being anticipated by European Patent Application EP 09490864 A2 of Moore’s et al. (hereinafter “Moore’s”). Applicants’ respectfully traverse this rejection on the basis of the following arguments, and further contend that Moore’s fails to disclosure all elements of these claims, as described below, and hence does not anticipate the claimed invention.

C. Summary of the Claimed Invention

Applicants’ invention is directed to a battery pack containing a plurality of cells for use with a charger or battery-powered devices, such as power tools. The battery pack includes a

plurality of cases with at least one air passage formed within one of the cases for allowing cooling air to enter from outside of the case and to pass along and between the cells before exiting from the case. A radiator is provided in the at least one air passage so as to be in contact with an outer surface of each of the cells. The radiator includes a plurality of portions, each of which corresponds to each of the cells contained in the case. The portions of the radiator have different heat dissipating capacities according to a heat load of a corresponding cell. As such, the sizing of the radiator portions vary to accommodate a heat load of a corresponding cell. In this manner, a proper temperature balance among each of the cells in the battery pack is achieved and maintained. Accordingly, this counters a problem of certain cells reaching the end of their life span faster than others due to overheating and thus increases the service life of the entire battery. See application page 4, lines 1-5.

D. Summary of the Moores European Patent Application

Moores describes a ventilated housing to hold one or more battery cells. Moores describes a heat sink positioned between each of the battery cells for removing heat from each of the cells. The heat sink includes projecting portions that surround the battery cells to remove heat towards fins of the heat sink. A plurality of openings is provided in the bottom of the housing to assist in cooling the fins of the heat sink. See column 6, lines 24-43, and Figures 4A-4C.

E. The Claimed Invention Distinguishes Patentability over the Moores Patent Application

Moores does not anticipate Applicants' amended claim 8 of the present invention. The cited Moores reference fails to disclose a battery pack that includes a first case containing a plurality of cells and a second case enclosing the first case. Moores does not disclose such a feature. Accordingly, Applicants' request that the rejection under 35 U.S.C. §102(b) be reconsidered and withdrawn.

Similarly, Moores fails to anticipate claims 9-12 which depend directly or indirectly on amended claim 8, and hence include its novel features. Accordingly, Applicants' request that the rejection of claims 9-12 under 35 U.S.C. §102(b) be reconsidered and withdrawn.

F. Rejection of Claims 1-4 and 8-13 under 35 U.S.C. § 102(a):

The Office Action rejects Claims 1-4 and 8-13 as being anticipated by JP 2000-133225 A (hereinafter “Japan”). Applicants’ respectfully traverse this rejection based on perfecting a right of priority claim 35 U.S.C. § 119.

The cited Japan reference fails to qualify as prior art under 35 U.S.C. § 102. Filed herewith are English language translations for each of the certified priority documents and two verifications of translations from the translator to perfect Applicant’s right of priority, in accordance with 37 C.F.R. 1.55(a)(4).

Accordingly, Applicants’ request that the rejection of Claims 1-4 and 8-13 under 35 U.S.C. § 102(a) be reconsidered and withdrawn.

G. New Claims

Applicants respectfully submit new claims 25-69. Support for the new claims can be found throughout the specification.

New claim 25 recites a battery pack containing a plurality of cells for use with a charger or a battery powered device, such as a power tool. The battery pack include at least one air passage formed within the case for allowing cooling air to enter from outside of the case and to pass along and between the cells before exiting from the case. A radiator is provided in the at least one air passage so as to be in contact with an outer surface of each of the cells. The radiator has a plurality of portions each corresponding to each of the cells, wherein the portions have different heat capacities according to a heat load of the corresponding cell. Moreover, the heat capacity of each portion of the radiator is determined by the area of contact of the portion with the corresponding cell. New claims 26- 40 depend either directly or indirectly from claim 25 and therefore incorporate the novel features of claim 25.

An advantage of the claimed invention is that the radiator is customizable to suit an amount of heat dissipation necessary to maintain a minimal thermal gradient across the plurality

of cells in the battery pack. As such, reliability and life expectancy of the battery pack is improved and extended.

The cited Moores reference does not disclose a radiator means having a plurality of portions where the heat capacity of each portion is determined by the area of contact of the portion with a corresponding cell. That is, Moores fails to disclose that depending on the arrangement of the cells and the locations of the cells along the airflow passage, both upstream and downstream, the heat capacity of each portion of the radiator is adjusted by selecting the area of contact of the portion of the radiator with a corresponding cell.

New claim 41 recites a battery pack containing a plurality of cells for use with a charger or a battery powered device, such as a power tool. The battery pack include at least one air passage formed within the case for allowing cooling air to enter from outside of the case and to pass along and between the cells before exiting from the case. A radiator is provided in the at least one air passage so as to be in contact with an outer surface of each of the cells. The radiator has a plurality of portions each corresponding to each of the cells, wherein the portions have different heat capacities according to a heat load of the corresponding cell. Moreover, the heat capacity of each portion of the radiator is determined by the thickness of the portion corresponding to a cell. New claims 42- 56 depend either directly or indirectly from claim 41 and therefore incorporate the novel features of claim 41.

An advantage of the claimed invention is that a thickness of the radiator is customizable to suit an amount of heat dissipation necessary to maintain a minimal thermal gradient across the plurality of cells in the battery pack. As such, reliability and life expectancy of the battery pack is improved and extended by effective cooling of each cell to result in a minimal thermal gradient across the cells.

The cited Moores reference does not disclose a radiator means having a plurality of portions where the heat capacity of each portion is determined by the thickness of the portion corresponding to a cell. That is, Moores fails to disclose that depending on the arrangement of

the cells and the locations of the cells along the airflow passage, both upstream and downstream, the heat capacity of each portion of the radiator is adjusted by selecting the thickness of the portion of the radiator with a corresponding cell.

New claim 57 recites a battery pack containing a plurality of cells for use with a charger or a battery powered device, such as a power tool. The battery pack include at least one air passage formed within the case for allowing cooling air to enter from outside of the case and to pass along and between the cells before exiting from the case. A radiator is provided in the at least one air passage so as to be in contact with an outer surface of each of the cells. The radiator has a plurality of portions each corresponding to each of the cells, wherein the portions have different heat capacities according to a heat load of the corresponding cell. Moreover, the heat capacity of each portion of the radiator is determined by the material of the portion corresponding to a cell. New claims 58- 72 depend either directly or indirectly from claim 57 and therefore incorporate the novel features of claim 57.

An advantage of the claimed invention is that a material of the radiator is customizable to suit an amount of heat dissipation necessary to maintain a minimal thermal gradient across the plurality of cells in the battery pack. As such, reliability and life expectancy of the battery pack is improved and extended by effective cooling of each cell to minimize a thermal gradient across the cells.


The cited Moores reference does not disclose a radiator means having a plurality of portions where the heat capacity of each portion is determined by the material of the portion corresponding to a cell. That is, Moores fails to disclose that depending on the arrangement of the cells and the locations of the cells along the airflow passage, both upstream and downstream, the heat capacity of each portion of the radiator is adjusted by selecting the material of the portion of the radiator with a corresponding cell.

CONCLUSION

In view of the amendments and remarks set forth above, Applicants contend that claims 1-72 presently pending in this application, are patentable, and in condition for allowance. If the Examiner deems there are any remaining issues, we invite the Examiner to call the undersigned at (617) 227-7400.

Respectfully submitted,

LAHIVE & COCKFIELD, LLP

A handwritten signature in black ink, appearing to read "David R. Burns", written over a horizontal line.

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“VERSION WITH MARKINGS TO SHOW CHANGES”

In the Claims:

Please amend the claims as follows:

1. (Twice Amended) A battery pack, comprising:
 - a case containing a plurality of cells,
 - at least one air passage formed within the case for allowing cooling air outside the case to enter the case and to pass at least one of along and between the cells, and exit from the case, and
 - at least one radiator provided in the at least one air passage so as to be in contact with [one or more] an outer surface[s] of the cells, wherein the heat capacity of the at least one radiator increases in the downstream direction of a flow of the cooling air.

6. (Amended) A battery pack in accordance with claim 5, wherein the radiator fins of each plate include[s] a plurality of horizontal fins with different lengths, the fins being arranged in parallel both with respect to any of the other fins in the plate and to the direction of the cooling airflow such that the heat capacity of each radiator increases in the downstream direction of the cooling air.

8. (Twice Amended) A battery pack, comprising:
 - a first case containing a plurality of cells,
 - a second case enclosing the first case,
 - at least one air passage formed within the first case for allowing cooling air outside the first case to enter the first case at an upstream portion of the at least one air passage and to pass at least one of along and between the cells, and exit from the first case at a downstream portion of the at least one air passage, and
 - radiator means provided in the at least one air passage so as to be in contact with [one or more] an outer surface[s] of each of the cells, the radiator means having a plurality of portions each [of which corresponds]corresponding to [at least one] each of the cells, wherein the portions

have different heat capacities according to a heat load [the heat conditions] of the corresponding cell[s].

13. (Twice Amended) A battery pack in accordance with claim 8, wherein the cells are divided into at least one first cell group and at least one second cell group, each said first and second cell group including at least one cell and having [different heat conditions] a heat load distinct from the others, and the radiator means includes a plurality of radiator plates having different heat capacities, each radiator plate being in contact with one of the first and second cell groups.

14. (Amended) A battery pack in accordance with claim 13, wherein the battery pack comprises one first cell group located generally in the center thereof and two second cell groups [interposing]opposing the first cell group [across]along branches of the at least one air passage.

15. (Twice Amended) A battery pack in accordance with claim 14, wherein the radiator plates include a first radiator plate and two second radiator plates, the first radiator plate surrounding the first cell group at its outer [around an entire] periphery and each of the second radiator plates abuts inner surfaces of one of the second cell groups, and wherein the first radiator plate has a smaller heat capacity than each of the second radiator plates.

18. (Amended) A battery pack in accordance with claim 15, wherein the first radiator plate and the second radiator plates have a plurality of portions adapted to correspond[ing] to locations of different cells in the battery pack and adapted to remove heat from the corresponding cells at each portion, said portions having different heat capacities according to the heat [conditions]loads of the corresponding cells.

23. (Amended) A battery pack in accordance with claim 14, wherein each second cell group has inner surfaces in contact with one of the second radiator plates, and each second cell group is arranged in a single row of cells bent at one intermediate cell toward the inner surface, the portion of each second radiator plate corresponding to the intermediate cell includes[including]

two bulges adjacent to[and interposing] the intermediate cell so that the intermediate cell interposes therebetween.

24. (Amended) A battery pack in accordance with claim 23, wherein each bulge is thicker than the [reminder]remainder of the second radiator plate.

In the Specification:

Please replace the paragraph beginning at page 1, line 4, with the following rewritten paragraph:

-- This application claims priority on Japanese Patent Application No. 11-321621 filed on November 11, 1999 and Japanese Patent Application No. 2000-293719 filed on September 27, 2000. --

Please replace the paragraph beginning at page 3, line 36, with the following rewritten paragraph:

-- The invention is also directed to a battery pack comprising: a case containing a plurality of cells; at least one air passage formed within the case for allowing cooling air outside the case to enter the case, pass along and/or between the cells, and exit from the case; and radiator means provided in the at least one air passage so as to be in contact with outer surfaces of the cells, the radiator means having portions each of which corresponds to at least one of the cells, wherein the portions have different heat capacities according to the heat conditions of the corresponding cells.

[a battery pack that can more effectively counter variations in temperature of the cells that occur due to, for example, increases in temperature of the cooling air in the pack] --

Please replace the paragraph beginning at page 4, line 29, with the following rewritten paragraph:

-- According to one practice of the present invention, the battery pack comprises one first cell group located generally in the center thereof and two second cell groups [interposing] opposing the first cell group across branches of the at least one air passage. --

Please replace the paragraph beginning at page 5, line 21, with the following rewritten paragraph:

-- In accordance with still another aspect of the present invention, each second cell group has inner surfaces in contact with one of the second radiator plates, and each second cell group is arranged in a single row of cells bent at one intermediate cell toward the inner surface, the portion of each second radiator plate corresponding to the intermediate cell including two bulges adjacent to [and interposing] the intermediate cell. --

Please replace the paragraph beginning at page 5, line 26, with the following rewritten paragraph:

-- In accordance with yet another aspect of the present invention, each bulge is thicker than the [reminder] remainder of the second radiator plate. --

Please replace the paragraph beginning at page 10, line 1, with the following rewritten paragraph:

-- Also provided in the rear portion 58 of the connecting portion 54 is a terminal block 59 which includes charging terminals 60, a temperature detection terminal 61, and a connector type data transmission terminal 62. Referring to Figures 8 and 9, a cooling fan 63 is provided inside the charger case 51 rearward of the terminal block 59. The fan 63 is positioned along the longer side of the charger case 56 and has an upwardly-directed airflow supply port 64 connected in communication with a square airflow passageway 66 which is integrally formed in the upper case 52. The cooling fan 63 additionally includes an intake port 65 which faces rearward. Also integrally formed in the lower case 53 are air intake ports 67 for supplying cooling air. Furthermore, a partition wall 68 is provided in the lower case [63] 53 so as to enclose the portion of the fan 63 lying within the lower case [63] 53, whereas a corresponding vertically-disposed partition wall 69 is integrally provided in the upper case 52 so as to conform to the upper surface of the fan 63 other than the portions connecting the airflow supply port 64 and the airflow passageway 66. In this way, only air from the exterior of the charger 50 is supplied to the fan 63 through the intake port 65. --

Please replace the paragraph beginning at page 11, line 10, with the following rewritten paragraph:

-- According to the above embodiment, the battery pack 1 has a dual structure in which the cells 14 are housed in the inner case 13, which is in turn contained within the outer enclosure 2 with the first air passages 24 and the second air passage 25 separated from the cells 14. Additionally, the radiator plates 22 are provided in the part of the first air passages 24 and the second air passage 25 where they come into contact with the outer surfaces of the cell groups, with each radiator plate including fins 23, the number of which increases toward the downstream direction of the cooling airflow. This results in a greater heat capacity of each radiator plate 22 [with in] within the downstream direction of the airflow and thus ensures an appropriate cooling effect of the plates 22 despite increases in temperature of cooling air downstream. Due to this arrangement, as the cells have an even temperature distribution, i.e., the relative temperatures of the cells 14 are maintained at about the same level, resulting in an increase in the overall service life of the battery. Moreover, the provision of the fins 23 advantageously and easily augments the surface area and volume of the plate and thus the overall heat capacity of each radiator plate 22. --

Please replace the paragraph beginning at page 14, line 13, with the following rewritten paragraph:

-- Upon commencement of charging, the fan 63 sends cooling air into the outer enclosure 2 via the airflow passageway 66 of the charger 50, the pack's intake port 9, and the cylindrical channel 75. Thereupon, the cooling air flows through the guide passage 76 of the lower holder [76] 16 and the air passage 72 within the inner enclosure 13 and eventually exits to the exterior of the battery pack 1 through the discharge ports 11, while suppressing increases in temperature of the cells by cooling the radiator plates 73 and 74. Particularly in this embodiment, different materials are selected for the radiator plates 73 and 74 in consideration of the difference in the heat conditions between the respective cell groups. Furthermore, the cells in the cell group 70 have different areas of contact with the radiator plate 73, and each of the radiator plates 73 and 74 includes portions having different thicknesses. The purpose of these features of the radiator plates is to provide a suitable heat capacity for different plate portions that are brought into contact with cells with different heat buildup characteristics. Accordingly, these arrangements can effectively cope with variations in the temperature of the cells 14a-14f, for example, due to increase in temperature of the cooling air downstream, maintaining a proper temperature balance

among the cells 14a-14f. This addresses the problem of certain cells reaching the end of their life span faster than others, thus increasing the service life of the entire battery more effectively than the arrangement of the first embodiment. Moreover, the charging time is shortened as the cells of this embodiment [is] are well protected against excessive heat buildup. That is, in conventional battery chargers, the charging circuitry is protected by a reduction in the charging current, which results in longer charging times. However, the relationship between temperature and charging time also means that cooling allows the charging current to be similarly increased, thus shortening the charging time. --

Please replace the paragraph beginning at page 14, line 37, with the following rewritten paragraph:

-- According to this embodiment, as the heat capacity of the radiator plates 73 and 74 and the distribution of heat capacity in each type of plate are adjusted by the selection of different materials for the plates 73 and 74, the use of [differring] differing areas of contact of the cells in each group 70 with the plate 73, and the provision of portions with different thicknesses in the plates 73 and 74, the heat capacity of different plates and/or different portions of the plates can be more easily and effectively adjusted. If more than one of these arrangements/means are combined, adjustment of the heat capacity of the plates becomes even easier and more accurate.

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